REMARKS

Favorable reconsideration is respectfully requested.

The claims are 15-26.

Undersigned acknowledges with appreciation the helpful interview with Examiner Balasubramanian on September 10, 2003.

No specific agreements were reached at said interview.

A summary of the representations made at said interview are included in the remarks below.

Before proceeding further, it should be noted that the present Official Action apparently crossed paths with the Supplemental Response of May 19, 2003. Therefore, such Supplemental Response should not be considered fully responsive to the present Official Action, but merely as a supplement to the previous response.

Claims 22 and 26 have been objected to for failing to further limit claim 15 on which they depend.

In reply, claim 15 calls for a cooling step and a quenching step. Claims 22 and 26 merely recite the conditions of the quenching step. Therefore, it is considered that claims 22 and 26 further limit claim 15 on which they ultimately depend.

Claims 15 to 17 and 19-21 have been rejected under 35 U.S.C. 102(b) as anticipated by Kokubo (U.S. 3,637,686).

This rejection is respectfully traversed.

A brief discussion of the present invention will be of assistance in appreciating Applicants' reasons for traversal of the rejection.

The present invention is based on an advantageous method of recovering melamine from a melt prepared from urea in a high-pressure process. The instant method involves cooling of the melamine melt down to a temperature close to the solidification point i.e. melting point, but still above the melting point. In claim 15, this is expressed as "about 1 to 50°C above the melting point of melamine which is dependent on the ammonia pressure."

In the attached diagram, it can be seen how this first step is conducted, i.e. so that the molten melamine is cooled to a temperature just above the solidification point, by the addition of ammonia.

In the second cooling step, the melamine at just above the melting point is quenched with an aqueous solution such as water, aqueous ammonia etc., which is an inexpensive means for cooling.

Further, the water-ammonia mixture can be used directly for cooling without separating them or the ammonia can be stripped off, as disclosed on page 7, lines 10 to 13 of the present specification. See also claims 17 and 25 in this regard.

Thus, the present invention employs water as a cooling agent <u>to effect phase transition from the molten state to the solid state in an economical and efficient manner</u>.

These features are neither disclosed nor suggested by the prior art as will be discussed in detail below.

Claims 15 to 17 and 19 to 21 have been rejected under 35 U.S.C. 102(b) as anticipated by Kokubo (U.S. 3,637,686).

This rejection is respectfully traversed.

<u>Kokubo</u> employs a two step cooling process for recovering purified melamine which is very different from that presently claimed.

In a first step, crude molten melamine or a mixture of melamine with ammonia and carbon dioxide etc. passes through pipe 1 into a pressure cooler 2, in which the first stage i.e. cooling section 23 cools the molten melamine to a temperature range of 200-270°C to solidify it and in the second stage i.e. in cooling section 18, the product is cooled from 200-270°C to 100-200°C by quenching with aqueous ammonia. See column 4, lines 52-63.

Further, as pointed out in column 2, lines 30 et seq., the cooled molten melamine is cooled under pressure to 200-270°C (to avoid deammoniazation condensation and hydrolysis, which hardly occurs at less than 300°C) where it solidifies. After cooling to solidification of the melamine in the first step, the hydrolysis of the crude melamine can be well controlled by further

cooling the solid melamine to 100-200°C by means of an aqueous solution containing ammonia (col. 2, lines 59 to 64).

While Kokubo states that the crude <u>molten</u> (emphasis) melamine is cooled to 100-200°C by means of the aqueous solution containing ammonia, what is meant is that initially, the material being treated was molten, however, it became solidified at 200-270°C as pointed out in column 2, lines 58-60.

Therefore, the melamine <u>cannot again be solidified</u> by quenching into aqueous ammonia to bring it to a temperature of 100-200°C since it had been previously solidified at 200-270°C.

A comparison of the present process and Kokubo can bee seen from the attached diagram in which the first step of the present process is conducted in the shaded area above the melting point line.

The second step is conducted in the present process below the melting point line.

On the other hand, in Kokubo, the first step involves solidification (of course below the melting point) and the aqueous quench takes place <u>after</u> the melamine has already been solidified in the preceding step.

There are several operational advantages to proceeding in this manner and these will be discussed below. However, even in the absence of these advantages, the steps themselves are simply unobvious from the teaching of Kokubo.

With regard to the advantages of the present method over Kokubo:

1. <u>Less Cooling Medium is Needed</u>

In Kokubo, all of the cooling energy for the solidification has to be transferred to the molten melamine in the first step. In any case, LIQUID ammonia is used to solidify the melamine once inserted into the pressure cooler 23 in Fig. 1 is gaseous or becomes gaseous instantaneously. The temperature in the pressure cooler is above 200°C and ammonia is gaseous at this temperature. <u>There is NO cooling of molten melamine with liquid ammonia.</u> The ammonia only exists in the pipe leading into the pressure cooler. Once in the <u>pressure cooler, liquid ammonia flashes off</u>.

Therefore, the large cooling step has to be achieved by a GAS to a LIQUID heat transfer, which is an order of magnitude less efficient than a LIQUID to LIQUID heat transfer. In the present invention, there might also be some cooling with gaseous ammonia but only to temperatures above the melting point, i.e. the amount of heat removed is MUCH less than that used by Kokubo to solidify melamine. The BIG cooling step in the present invention is achieved by a LIQUID medium used to effect PHASE TRANSITION from melt to solid (slurry).

2. Cooling is Less Complicated and Requires Less Space

The gaseous cooling apparatus of Kokubo is large, complex and costly (see Fig. 1).

The instant process, in contrast, does not require a large, complex apparatus since the small amount of gaseous ammonia which might be used in the first cooling step of the instant process (e.g. 370°C down to e.g. 320°C) takes place at high pressure i.e. less room is required.

The quenching step, i.e. the second step in the instant process, is achieved by using an ammonia/water mixture which is always liquid throughout and therefore less space is needed.

3. No Ammonia Recovery Necessary

Kokubo uses water-free ammonia to solidify molten melamine in the first cooling step (cooler 23 in Fig. 1; 370°C to 270°C - 200°C).

Kokubo uses water in the second cooling step (section 18 in Fig. 1) of Kokubo.

The water ammonia mixture in cooler 2 in Fig. 1 has to be separated: first it passes through a degassification column (column 5 in Fig. 1, col. 5, line 10 of Kokubo). The gas overhead containing water and ammonia is fed into the ammonia distillation column 20. The ammonia goes overhead. In fig. 1 it is compressed and then fed back to the pressure cooler.

Such costly ammonia recovery is not necessary in the present process. The cooling medium in the present invention has NOT to be water-free. The water/ammonia mixture can be used directly for cooling WITHOUT separating the two (see page 7, lines 10-13 of the application). This saves on apparatus costs and energy costs.

The foregoing demonstrates that the instant process has considerable advantage over Kokubo. It is not a matter of yield or purity alone - the process itself is better.

The Official Action states that a variation in temperature would influence yield and purity.

In reply, the difference between the present invention and Kokubo is not only temperature but also the phase in which the various cooling steps are performed as well as the very simplicity of operation.

As a final point, the rejection on Kokubo at the top of page 4 states that the claim language permits "about 1 °C which can include the melting point temperature of melamine or melamine in the molten state" and that one skilled in the art would know that such a small variation in temperature is permissible in an industrial process and would consider a few degree variation from the teaching of Kokubo as acceptable as long as the melamine is in the molten stage.

However, this analysis is not correct because the present invention does not merely optimize temperature in Kokubo's process, but involve selection of temperature, phase and cooling method. Thus, for example, <u>aqueous quenching does not occur in transition of melamine from the molten to the solid stage in Kokubo,</u> in contrast to the present invention.

For the foregoing reasons, it is apparent that the rejection on anticipation over Kokubo is untenable.

Claims 15-26 have been rejected as unpatentable over Kokubo in view of Ullmann's Encyclopedia of Industrial Chemistry (Ullmann).

In reply, there is nothing in Ullmann which overcomes the very fundamental deficiencies of Kokubo, as discussed above.

Similarly with regard to the rejection of claims 15-26 as unpatentable over Kokubo in view of Manes (U.S. 3,386,999).

In Manes, a low pressure vapor phase process quenches a <u>gaseous mixture</u> consisting of melamine, ammonia and carbon dioxide, <u>with water vapor</u> prior to cooling of the gaseous mixture to condense solid melamine, whereby cyanic acid is hydrolyzed in the gaseous mixture to form ammonia and carbon dioxide and melamine is condensed as a pure solid, substantially free of urea and melamine precursors.

It is not seen how this vapor phase quench has anything to do with the aqueous quench of Kokubo or the present process, <u>which clearly do not take place in the vapor phase</u>.

Claims 15-26 have been rejected under 35 U.S.C. 103 as being unpatentable over Canzi et al. (U.S. 5,721,363) in view of Van Hardeveld (U.S. 4,408,046).

This rejection is also respectfully traversed.

Canzi cools a melamine melt from the temperature of 330°C to 270°C and cooling does not stop just above the melting point, in contrast to the present process.

Further, Canzi cools to solidify in a water-free manner. Neither water in liquid nor vapor phase is introduced into the melamine melt of Canzi, in contrast to the present invention.

There is another disadvantage of Canzi et al. since this process transfers a melt directly into solid particles. This dry solidification process is much more difficult to handle than a crystallization from a solution or a suspension, the latter being the case for the instant process. The powder in Canzi tends to lump together, blocking equipment. In the instant process, the powder is obtained at the very end of the process. Before that, the suspension solution is "pumpable".

Moreover, the quality of the instant product is surprisingly superior to that of Canzi. In this regard, as stated above, the main difference is dry cooling (Canzi) vs. wet cooling (instant invention). The effect of the difference in the cooling mechanisms is not so much the melamine purity, but the color appearance of the melamine. The color appearance is indicated by the APHA value.

The APHA value is a well-known measure for the yellowish tinge the melamine might have after solidification. The lower the APHA value, the better; i.e. the melamine will be less yellowish. The higher the APHA value, the more yellow will be the melamine.

Two examples for APHA values as obtained by the Canzi process are as follows:

EXAMPLE 1

Molten melamine was kept at a pressure of 76 bar for 75 minutes. Subsequently, the melamine was cooled by a defined cooling program to 240°C, thereby solidifying the melamine. Then the melamine was depressurized and the melamine was slowly cooled to ambient temperature.

The analysis yielded the following results:

Ammelide	50 ppm
Ammeline	135 ppm

Ureidomelamine	50 ppm
Melam	410 ppm

The APHA value could not be determined due to the opacity of the liquid; the APHA value would have been excessively high.

EXAMPLE 2

Melamine is treated as above but is kept under a pressure of 105 bar for 90 minutes. The defined slow cooling was performed to 250°C.

The analysis yielded the following results:

Ammelide	50 ppm
Ammeline	132 ppm
Ureidomelamine	50 ppm
Melam	300 ppm

The APHA value could be measured, but was larger than 100.

EXAMPLE 3

In a representative experiment of the present invention, the melamine was produced in high pressure melamine reactor at 373.5°C and 135 bar. The off gases were separated and the CO_2 was removed. Cooling of the melamine melt was effected by gaseous ammonia from 373.5°C (reactor temperature) to 361.5°C (temperature is 1 to 50°C above the melting point). The resulting melt was then quenched with an aqueous ammonia solution. After the quenching, the melamine is in a solution. After the crystallization, the APHA value was 5.

Van Hardeveld teaches a purification process which employs melamine from other processes, including high pressure or low pressure processes.

However, Van Hardeveld is silent on how to solidify the melamine melt and in fact Van Hardeveld assumes that low and high pressure processes can be employed. In this regard, in the case of the low pressure process, melamine melt would not even occur since melamine is in the gaseous phase.

Another reason why there is no motivation to combine the teachings of Canzi and Van Hardeveld lies in the nature of the Canzi et al. process which is a "dry" process, i.e. no water is used. It is unobvious to introduce a "wet" process step in the Canzi et al. teaching without

motivation for so doing. Van Hardeveld dissolves solid melamine water whereas the present claimed method employs aqueous solution to quench the melamine melt.

There is no teaching in Van Hardeveld whatsoever concerning the cooling of the melt to the presently recited target range above the melting point and then to perform the aqueous quench, but in contrast, Van Hardeveld employs the aqueous quench without regard to the melamine phase or temperature.

Accordingly, the rejections on prior art are untenable and should be withdrawn.

No further issues remaining, allowance of this application is respectfully requested.

An Information Disclosure Statement accompanies.

If the Examiner has any comments or proposals for expediting prosecution, please contact undersigned at the telephone number below.

Respectfully submitted,

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Melamine Temperature in dependence of pressure
Physical Property Source: US 6 380 385 B1 Canzi et al. (Column 5, lines 13-25; Table 1 and Fig. 1)